DEVELOPING FORESTRY STRATEGIES FOR AB 32

Summary of CAT Reforestation/Afforestation Strategy – Target: 2 MMT CO2e/yr in 2020

Many areas of public and private ownerships in California remain below natural stocking capacity due to past wildfires and other disturbances. The CAT report proposed reforesting (replanting previously forested areas that have had less than 10% canopy cover for at least 10 years) 430,000 acres over 12 years. This would produce an annual GHG benefit of 2 MMt CO2e in 2020, and cost a total of $312 million over the whole period.

The strategy as described would include participation by private landowners, state agencies, and others, such as non-profit organizations and local government. The strategy did not include federal landowner agencies.

Three initiatives were analyzed:

- Reforesting 7,000 acres per year for 10 years, starting in 2008, on private land on ownerships of up to 5000 acres through the CA Forestry Improvement Program
- Reforestation of 25,000 ac/yr for 12 years on private lands through GHG offset market , starting in 2008
- Reforesting 4,700 ac/yr of state owned lands for 12 years, starting in 2008.

Other actions that could contribute to reforestation for which GHG benefits were not estimated include incentives such as tax credits for private lands, public lands reforestation (e.g. USFS), and tree planting for bioenergy.

Statutory Status

Additional budgetary action and legislative support would be needed to enhance CFIP funding. Legislation would be needed for new tax policy.

Implementation Assumptions: Steps and Timeline

In order to implement the actions and timeline above, this strategy assumed:

- CFIP augmentation to $5 million/yr which would require legislative action to obtain stable funding (up to $2 million may be available from Jackson State revenues starting in 2008)
- Voluntary markets for forestry offsets would be operant by 2008, and ARB would establish regulatory market and approve forestry offsets by 2011. The market will pay $9.71 per t CO2 for forestry offsets, which would provide adequate economic incentive to landowners to reforest the proposed acreage (Brown et al., 2004).
- Availability of $20 million/year to state agencies (for a total of $232 million over next 12 years) to conduct reforestation projects on state lands.

GHG Reduction

The analysis of GHG benefits used the following assumptions:

- CFIP and GHG market projects would occur on forests and woodlands with high biomass production potential; state land reforestation would occur on woodlands and rangelands with lower biomass potential.
- Trees will be held for 20 years. This is considered the minimum period needed for a tree planting project to accumulate measurable carbon.
- Statewide weighted carbon stock of a 20-year old forest project is 101 t CO2/ac (Brown et al. 2004) which equates to an average annual benefit (sequestration) of 5 tons CO2/ac/year. The average annual benefit for woodlands is 2 t CO2e/ac/year.

- These averages assume a linear accumulation of biomass, when in fact biomass accumulates slowly at first and then at increasing rates. Thus these rates overestimate benefits early in the project, but underestimate benefits in 2020. For projects retained for longer periods of time, the annual benefits exceed these averages.

GHG benefits are calculated by:

1) Multiplying cumulative planted acreage at end of each year by appropriate sequestration rates, i.e. 5 tons/ac for market and CFIP programs and 2 tons/ac for state lands.
2) 2020 benefits are calculated by adding annual program results for each measure for a total of 1.98 MMt CO2e:
   - 0.35 MMT from CFIP activities (7,000 ac forestland reforestation/yr for 10 years)
   - 1.52 MMT from private lands through GHG offset market (25,000 ac/yr)
   - 0.11 MMT from state-owned land (4,700 ac/yr for 12 years).

These projects will increase standing carbon stocks by over 4 MMt which translates to a cumulative sequestration of over 15 MMt of CO2 during this period.

Costs and Savings and Other Benefits

- Total cost of 10-year CFIP reforestation is $49 million ($35 million state operating and $14 million private operating). Annual costs are $3.5 million and $1.4 million respectively. (The balance of the $5 million annual CFIP augmentation would be directed to fuels reduction activities). Cost analysis assumed that average reforestation cost is $700/ac (site preparation, planting and maintenance). CFIP funds $500 and landowner covers $200.
- Total cost of 12 years of market-based reforestation is $224 million ($42 million capital costs and $182 million operating costs). Annual costs are $3.5 million and $15.2 million respectively.
- 12 years of reforestation on state lands would cost about $39 million ($6 million capital and $33 million operating). Annual costs are $500 thousand and $2.8 million respectively. (It may be appropriate to remove the capital costs for state lands).

Potential Next Steps

1. Review assumptions about private land availability for reforestation. Redraft actions, as needed.
2. Review assumptions about state land reforestation opportunities and cost analysis.
3. Consider potential actions for which GHG benefits were not analyzed, e.g. reforestation potential for federal lands.
4. Consider role of reforestation projects in meeting 2050 goals, and need for GHG benefit recalculation.

(Consider reforestation of younger burns under Conservation Forest Management).

Reference

Brown, S. et al. 2004. Carbon Supply from Changes in Management of Forest, Range, and Agricultural Lands of California. Winrock International, for the California Energy Commission, PIER Energy-Related Environmental Research. 500-04-068F.

DEVELOPING FORESTRY STRATEGIES FOR AB 32

Summary of CAT Forest Conservation Strategy – Target: 0.4 MMt CO2e

Strategy Description

Projections of forest and woodland conversion in CA indicate that parcelization (development of one or more houses per 20 acres) will occur on 570,000 acres between 2000 and 2020 for a rate of 28,500 acres per year. Conservation of forest and woodlands through fee title acquisition or easements reduces greenhouse gas emissions that would have occurred due to vegetation removal associated with conversion and development. Conservation also maintains the capacity for those forests to sequester additional carbon, i.e. to reach full biomass capacity.

Conservation actions by state, federal and local agencies, landowners, local governments and non-profit organizations will produce an average annual benefit of 0.4 MMT CO2e in 2020 at a capital cost of $185 million through the following programs:

1. Prop 40/50 conservation by multiple agencies of 84,000 acres from 2005 to August 2006.
2. Projected Prop 84 forest protection and oak woodland preservation of 140,000 acres.

Other actions that may affect conservation benefits include carbon markets, state legislation and federal legislation. The benefits of these were not estimated.

Statutory Status

Possible areas for legislative action include reinstatement of State Forest Legacy Program, CEQA amendments to reduce GHG from forest conversion, and changes to the federal Forest Legacy Program to allow NGO's to hold easements.

Implementation Steps and Timeline

- This analysis assumed that $35 million of Prop 84 would be spent annually, from for the first four years ($31.5 million for forest habitat and $3.5 million for oak woodland) and $31.5 and $13.5 million the next 2 years.
- It assumed an average cost of $1,400 per acre, based on several recent California Forest Legacy Program projects. This is significantly higher than the average cost of forest and woodland habitat purchases listed in the Prop 40/50 database, resulting in a conservative estimate of reduced acres of forestland acreage converted to other uses and associated GHG benefits.

GHG Reduction

This analysis of conservation purchases estimates two types of GHG benefits that result by avoiding conversion: 1) one-time avoided emissions that would have occurred if vegetation were cleared for development, and 2) the avoided loss of additional growth and sequestration that would have occurred on the land. The latter benefit assumes that California forests are not fully stocked, i.e. they are still regrowing to full capacity after earlier decades of intensive clearing, logging and other disturbances.

The analysis incorporates detailed assumptions about the nature of development and impacts that would occur without conservation, and uses those assumptions to allocate conservation actions and to calculate associated GHG benefits.

- The exercise assumes that conserved acres would have been parcelized (developed with at least 1 house per 20 acres).
- It allocates conservation purchases to conifer forest, conifer woodland, hardwood forest and hardwood woodlands according to development risks for those vegetation types.
- For each vegetation type, it calculates the acreage that would be developed into 5-20 acre, 0.5-5 acre and <0.5 acre parcels (i.e. "interface", "urban" or "very urban" lots).

- It provides assumptions about the percent of vegetation removal associated with those development densities and uses those to calculate total acres that would have been cleared.

For each of the measures (Prop 84 programs and Prop 40/50 purchases), the annual GHG benefits from avoided clearing are calculated by:
1) Multiplying conserved acres (i.e. acres that would have been cleared for development) x tonnes of biomass/acre for each major vegetation type;
2) Dividing tonnes biomass by 2 to get tonnes of carbon;
3) Multiplying tonnes carbon by 3.67 to get tons of CO2;
4) Divide by 1000,000 to get million metric tonnes (MMT).
The avoided emission benefits for each vegetation type are added together for the total avoided emissions benefits per year.

The annual benefits of avoided loss of sequestration potential (i.e., how much additional vegetation growth would have occurred) are calculated by multiplying the acreage cleared in each of the vegetation types by annual biomass growth per acre for each vegetation type. The resulting tonnes of biomass are converted to carbon and CO2 values as described in steps 2-4 above. Results of all vegetation types are added together for total avoided lost sequestration.

The sum of these two types of benefits are added for each measure. Since one-time avoided conversion benefits are higher than avoided lost uptake, the majority of annual benefits occur during years of purchase, i.e. in 2005 and 2006 for Prop 40 and 50, and from 2008 to 2013 for Prop 84 programs. Therefore, while the total annual GHG benefit in 2008 is 0.73 metric tonnes of CO2, it is only 0.05 MMt CO2 in 2020. While an annual 2020 target may make sense for tailpipe emission benefits, it is problematic for sequestration benefits. The CAT report therefore used the average annual benefit of 0.4 MMt CO2.

<u>Costs, Savings and Other Benefits</u>

- About $54 million was already expended for the Prop 40/50 project benefits. As past expenditures, these were *not* included in the CAT Macroeconomic Analysis.
- This analysis assumes that $185 million from Prop 84 will be appropriated by WCB according to schedule in Implementation Steps above.

Conservation activities provide benefits such as wildlife habitat, watershed protection, recreation and open space values. These were not quantified for the macroeconomic analysis.

NEXT STEPS: Building on CAT analysis to develop actions for AB 32 Scoping Plan

1. Consider which actions are allowable under Scoping Plan cut off dates.
2. Consider whether to include Prop 84. Review implementation assumptions, e.g. costs per acre, allocation by veg type.
3. Consider federal land management decisions that place previously managed lands into reserve status ***(how does this apply to avoided development assumptions?).***
4. Review assumptions used to calculate GHG effects, e.g. one-time development vs 4x4 lot splits, statewide conversion risks vs regional rates, risk-related program criteria.
5. Consider simplifying analysis assumptions about vegetation types, percentages, etc.
6. Consider other types of actions or activities (eg policies, legislation, regulation, markets, private sector) and the feasibility of estimating GHG benefits for these initiatives.
7. Consider more comprehensive or quantitative description of other co-benefits.

DEVELOPING FORESTRY STRATEGIES FOR AB 32

Summary of Conservation-Based Forest Management Strategy – Target: 2.35 MMt CO2 e yr-1

Strategy Description

The purpose of the Conservation Forest Management Strategy is to change the management of forests in a manner that increases and maintains total carbon stocks on a forest ownership over time, relative to business as usual. This approach accounts for the landowner's planned actions, such as harvesting, forest improvement projects and natural disturbances. Options include increasing riparian buffer strips (required trees around streams to maintain stream quality), thinning to achieve maximum growth, inter-planting to maximize size utilization, removal of competing vegetation, enhanced management of crop trees to increase carbon sequestration, and pest/pathogen control.

Small private ownerships (<5000 acres) will be encouraged to voluntarily participate using technical and cost-share assistance programs. Incentive for large private ownerships will be the development and implementation of a carbon market. Public land managers control about half the timberlands in California, thus represent the biggest source carbon sequestration achieved since the 1980's, as well as the largest potential for further sequestration. Strategies for reductions that are inclusive of public lands have the largest potential impact on California forest carbon reductions.

The potential funding approaches analyzed in detail include the California Forest Improvement Program (CFIP) funding, the carbon market, collaboration with utilities, and tax credits.

Volume increases from changes in Forest Practice Act rules produces annual GHG benefits which were quantified.

Statutory Status

The CFIP fund exists (Public Resources Code 4790-4799.04), but requires augmentation and stability. Legislative action needs to be initiated in 2008 to establish reliable cost-share funding in CFIP and other cost share programs.

An appropriate legislative proposal to provide tax incentives will be developed by CalFire and other agencies, but doesn't currently exist.

Implementation Steps and Timeline

Of the following measures, only 1,2,4,5 were analyzed in detail.

1. CFIP augmentation legislative action in 2008, provide incentives by mid-2008 for private land forest projects.
2. Carbon market development before 2011.
3. Forest improvement projects on state lands. Identification of land parcels in 2007, technical assistance to managing agencies from 2008 onward.
4. Adoption of voluntary tariffs for forest projects by utilities. CalFire is working with PG&E, will begin contact with other utilities.
5. Tax incentives
6. Amend CCAR forestry protocols to allow registration of wood products.
7. Document carbon sequestered in forest management projects since 2004.

GHG Reduction

The strategy analysis combined the reductions of implementation approaches 1, 2, 4, and 5. Of all forest activity options for increasing carbon stocks, only riparian buffer strip extension (by 200 feet) was deemed certain to increase carbon stocks so it was the only approach analyzed.
Assume 1638 acres is added to riparian extension program yearly (19,656 by 2020), equivalent to 0.26 MmtCO2e per year by 2020.

Implementations approach 3 (state lands): More research is required to define whether areas exist in riparian zones on state lands that are currently under harvest cycles.

Implementation approach 6 (wood products): Wood products are included in the riparian benefit analysis, however as they are most important in the baseline they reduce the net carbon benefit rather than increase it. No cost is assigned to wood products in this analysis.

Implementation approach 7 (results of past actions): The carbon benefit of changes to the California Forest Practice Rules since December 2004 was calculated, equal to a total of 33.6 MMtCO2e by 2020, or 2.1 MmtCO2e per year over 16 years.

Costs, Savings and Other Benefits

Assume a worst-case-scenario where establishment of a permanent easement prohibits continued harvesting (usually permanent easements are negotiated to the mutual benefit of both parties and can include continued harvesting). Assume opportunity cost of lost timber harvest within extension zones. Assume current EU cost of $19.67/tCO2. Average net revenue of placing the land under easement is $1,010 per acre.

Preservation and extension of riparian buffers will lead to benefits to biodiversity and wildlife as habitat value is enhanced. Extended buffers will also benefit water supply and quality, lower stream temperature and improve stream habitat for aquatic organisms. Benefits include increased aesthetic values.

DEVELOPING FORESTRY STRATEGIES FOR AB 32

Summary of CAT Fuels Management/Biomass Strategy – 2.95 MMT in 2020

Strategy Description

Decades of fire suppression have resulted in high forest fuel loads (too many stems per acre), creating a fire hazard. Drought effects of climate change will exacerbate this. Forest fuel management projects produce GHG benefits by reducing wildfires and by providing biomass for energy and fuel production which reduces fossil fuel emissions. Increased fuel reduction on private and federal lands from 2007 to 2020 could produce 2.95 MMT CO2e in 2020 (.09 avoided emissions; 2.86 power and fuels) by treating:

1) 249,000 acres with State fuel reduction projects from 2007 to 2020
2) Over 2 million acres (143,000 per year) by federal agencies
3) 3.6 million acres from 2010 to 2020 to implement the CA Bioenergy Action Plan goals for biopower and biofuels.

Projects would be funded and implemented by local, state and federal agencies, non-profit organizations, private landowners and utilities. Other actions may enhance or be needed to implement these objectives, such as transportation subsidies, tax credits, Renewable Portfolio Standard (RPS) implementation, and reduction of barriers to sell power. Some of these are moving forward.

Statutory Status

Action is needed to augment CalFire's California Forestry Improvement Program funding and to continue the Sierra Nevada Forest Land and Fuels Management program after FY 08/09. CFIP changes to allow program use on larger ownerships might also enhance implementation. Actions from Bioenergy Action Plan (e.g. tax incentives, transportation subsidies and RPS implementation) may require legislation.

Implementation Assumptions, Steps and Schedule:

1. State funded programs for treatments on private and state lands would treat about 250,000 acres from 2008 to 2014 by:
   CalFire Programs:
   - Prop 40 Sierra Nevada fuel reduction program. $5 million per year for FY 2007/08 and 08/09 will treat up to 12,500 ac/yr. CalFire will seek additional funds to extend the program to 2014.
   - Augmenting CalFire's California Forest Improvement Program (CFIP) to $5 million annually, and using $1.25 million/year for fuels management. With landowner contributions, CFIP would treat over 4,000 acres per year from 2008-2020.

   Other state agencies:
   - Directing up to 10% of Chapter 6 Prop 84 wildlife habitat and forest conservation funding ($31.5 million) to treat 78,750 acres from 2008 to 2020, or 6,000-6,500 acres per year.
   - Directing 25% of Prop 84 Chapter 5 funds for CCC's Public Safety/Community Fuel Reduction ($6.25 million) to treat 15,625 acres from 2008 to 2020, or 1,200-1,300 ac/yr.
2. Federal agencies (e.g. USFS, NPS, BIA and BLM) would continue current mechanical fuel treatment rates of 143,000 acres annually for a total of 2.3 million acres.
3. Implement California Bioenergy Action Plan's goals for increasing biomass. This will require treating 3.6 million acres total from 2010 to 2020, reaching 460 thousand acres in 2020 for:
   - From 162,000 to 268,000 acres annually for biopower (2.4 million acres total)
   - From 29,000 to 192,000 acres for biofuel production (1.2 million acres total).

Additional funding will be needed for state programs (Sierra Nevada fuel reduction and CFIP) and to implement Bioenergy Action Plan.

GHG Reductions

- Avoided fire emissions are estimated by multiplying acreage treated x expected emissions for treated acreage.
    - Average emissions are calculated for 5 regions: avg GHG emissions = mean no. ignitions/acre, mean size and emissions/acre)
    - Treatments are assumed to reduce annual emissions by one half on treated acres
    - These estimates are considered very conservative since fire spread was not incorporated.
- Biomass energy benefits are estimated by multiplying treated acres x biomass removed x biopower production, and then determining the GHG benefits of substituting biopower for fossil fuel use.
- Biofuel production is estimated by multiplying acres treated x BDT removed/ac x 75 gallons/BDT. GHG benefits are calculated by multiplying no. gallons biofuel by per gallon GHG savings of biofuel compared to fossil fuel.

Costs, Savings and Other Benefits

A total cost of $13 billion is estimated (through 2020), using the following assumptions:

- $400 per acre for fuel hazard treatment
- $293 per acre for fuel preparation and transport to biopower or biofuel facility,
- $2,250 per kW for capital construction and 6 cents/kWh non-fuel operating costs for biopower, and 2 cents /kW subsidy for biopower facilities
- $200 million for 50 million gallon/year biofuel
- $3 per acre for GHG measurement, monitoring and verification.

Cost savings of $9 billion from avoided fire suppression was estimated, using a conservative savings of $1,500 per treated acre.

Costs savings associated with avoided wildfire damage on land, resources and property were not included. Air quality and health benefits associated with avoided emissions were also not included.

DEVELOPING FORESTRY STRATEGIES FOR AB 32

Summary of CAT Urban Forestry - 0.88 MMT C02e/yr in 2020

Strategy Description

This strategy sets a goal of establishing 5 million trees by 2010 in urban areas to sequester CO2, increase shading of buildings to reduce energy use for cooling, and provide wood waste biomass for bioenergy to provide a carbon neutral substitute to fossil fuel emissions. This will deliver 0.88 MMTC02e/yr in 2020 (0.14 from sequestration; 0.05 from shade related energy savings and 0.69 from biomass energy). Total tree planting costs were estimated at $860 million ($653 capital and $207 operating); cost savings were estimated at $751 million. Biopower production costs were estimated at $1.4 billion.

Urban forestry funding and implementation will be conducted by state programs, local government, non-profits, and utilities. Residential and commercial landowners are major targets for this strategy. Activities include:

1) CAL FIRE Urban Forestry programs resulting in the planting of up to 800,000 trees acres
2) Local agencies and non-profit urban forestry programs, e.g. Los Angeles' Million Tree program, the United Voices for Healthy Communities, Sacramento Tree Foundation, and others.
3) Coordinated actions by the Bioenergy Working Group to increase use of urban wood waste for biopower.

Other actions may be required for full implementation. These include tax credits or other incentives, deployment of technologies that can convert green waste into fuels or energy, investment in new power generating facilities, enhancements to CalFire's LA Moran Nursery in Davis, adoption of an urban forestry protocol by the Climate Registry and AB, and tree planting on state properties and around state buildings.

Statutory Status

The California Urban Forestry Act provides authority to Calf ire to plant trees and vegetation to reduce energy consumption and produce fuels and other products. Budget action would be needed to expand the CalFire program. Legislative action would also be required for new tax incentives or other incentives.

Implementation assumptions and time line:

- This strategy assumes that 6.2 million trees will need to be planted so that 5.5 million surviving trees are in place by 2020 and 5 million in 2030.
- It also assumes that two million dry tons of municipal green waste will be successfully diverted to produce up to 237 MW (two thirds of the potential assessed by CEC (2005).

1) Recent Urban Forestry Program grants will result in the planting of 800,000 trees, either directly or by assisting local agencies and non-profits.
    - Last Prop 12 grant solicitation for $1.7 million in FY 2007/08 for tree planting.
    - $10 million in Prop 40 grants from 2006/07 through 2009/10 to assist local forestry programs in planning, training and inventory.
    - Prop 84 Urban Greening Program (most recent budget information - $30 million from 2007/08 to 2013/14).
2) Investments in new biopower will begin in 2012. CalFire will work with Bio-Energy Working Group and the California Biomass Collaborative to promote investment in biopower facilities.

Additional funding is needed to implement this strategy. Other challenges are the time and coordination needed to site and permit the energy facilities needed for green waste utilization.

GHG Reductions

The following assumptions were used to calculate GHG benefits.

- Sequestration rates are 20% less than forest trees
- The species mix is 80% hardwood and 20% conifer
- 6% tree mortality in year 1 and 1 % per year thereafter.

GHG benefits calculation for:

1) Sequestration:
   - Multiply number of established trees x carbon biomass/tree x CO2 factor (3.67 t C02/t carbon). The benefit in 2020 is estimated to be 0.14 MMt CO2.
2) Biomass energy:
   - Calculate energy production from wood waste: 1,764 GWh in 2020.
   - CO2 benefit: 1,764 GWh x 390,000 kg CO2/GWh x 2.2 lb/kg x tonne /2205 lbs x 1MMt/1,000,000 tonnes = 0.69 MMt CO2e benefit.
3) Shade benefits:
   - Winrock modeled tree growth, shade and associated avoided energy use: 163 GWh in 2020.
   - CO2 benefits: 163 GWh x 313,000 kg CO2/GWh x 2.2 lb/kg x tonne/2205 lbs x 1 MMt/1,000,000 tonnes = 0.05 MMt CO2.

Total benefits are 0.88 MMt CO2. Annual benefits will increase over time due to tree growth. Sequestration benefits in 2030 are estimated at 0.25 MMT CO2 and shade savings at 0.06MMt CO2.

Costs. Savings and Other Benefits

This analysis assumes an average planting cost of $1 00 per tree, maintenance cost of $14-19 per tree, and survey costs of $2.19 per tree for a 5% sample every 5 years.

- Total tree planting capital and operating costs to 2020 were estimated at $653 million and $207 million respectively. Cost savings were calculated at $752 million.
- Biopower facility costs were estimated at $1.4 billion ($702 million capital and $704 million operating costs).
- Pollutant reduction savings (03, N02, PMI0 and VOC) of 0.03 tons per ton CO2 reduction were incorporated in analysis.
- Stormwater runoff management cost savings are included (4.73 gallons ppt per lb CO2 at $0.0002/gallon).
- Additional benefits (health, scenic, property) are included at $199 per MMt CO2.

References

California Energy Commission. 2005. Biomass Resources in California: Preliminary 2005 Assessment. CA Biomass Collaborative. Report# CEC-500-01-016.